San Joaquin County and Delta Water Quality Coalition
3422 W. Hammer Lane, Suite A
Stockton, California 95219
209-472-7127 ext 125

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Pamela Creedon
Executive Officer
Central Valley Water Board
11020 Sun Center Drive. Suite 200
Rancho Cordova, CA 95670

RE: San Joaquin County & Delta Water Quality Coalition's Comments on the Actions to Protect Beneficial Uses of the Sacramento-San Joaquin Delta

After reviewing the staff report, the San Joaquin County & Delta Water Quality Coalition (SJC & DWQC) has some major concerns about actions being proposed and studies being used to determine the actions needed to protect beneficial uses of water in the California Delta. SJC & DWQC believes the program is looking very narrowly at the inputs from the Delta islands as a means to solve the Pelagic Organism Decline.

The proposed actions are not based on any peer reviewed science designed to determine the cause of the decline in the health of aquatic communities in the delta. Within the staff report "the need for increased enforcement" or "restrictions of in Delta Pesticide Use" is mentioned five times. The question is what scientific data or studies are these conclusions based? Is there a weight of evidence that the decline of aquatic communities is caused by Delta agriculture's use of pesticides? Is there any scientific evidence or data suggesting that current pesticide label rates and application requirements are being exceeded by applicators in the Delta? Without an affirmative response to these questions. it is premature to suggest that increased enforcement or further restrictions on in-Delta pesticide use is necessary.

This is a case of guilty until proven innocent. The staff report assumes that Delta agriculture is a source of contaminants causing the decline in the health of the delta aquatic communities. These are hypotheses about sources and causes of the decline. As such, they should be evaluated scientifically. Elevating hypotheses to the level of fact will no elucidate the causes of POD in the Delta or further the process of scientific inquiry to improve the overall health of the Delta. In fact, spending resources implementing policies that are not based on sound science is a detriment not only to the Delta but to those whose resources are being frivolously wasted.

The SJC & DWQC is especially concerned about a study the Regional Board will rely on to determine whether there are contributions of pyrethroid pesticides from Delta Islands that could effect pelagic organism decline within the Delta. Several scientists who reviewed the study for SJC & DWQC concluded it is flawed and will not help determine if pyrethroids are having an adverse effect on aquatic communities in Delta. The study's

experimental design cannot show a causal link between pyrethroids and impacts on aquatic communities in the Delta.

The conceptual framework for the study is as follows: If pyrethroid-caused toxicity cannot be found in water discharged directly from sources, there will be no evidence to support the possibility that pyrethroids are impacting POD organism food supplies in the pelagic zone (i.e., if a conservative test cannot detect an effect, none exists). Alternatively, if toxicity can be detected, there is assumed to be effects of pyrethroids on aquatic communities in the Delta. If placed into the framework of evaluating conceptual and formal hypotheses, the study design and the conclusions to be drawn violate basic principles of hypothesis testing because: 1) the proposal focuses on the tests to be performed rather than the interpretation of the test results (the proposal does not establish a formal hypothesis for evaluating whether pyrethroids are the cause of toxicity in discharge waters); and 2) there is a confounding of conceptual and formal hypothesis testing and a misunderstanding of alternative hypotheses and their interpretation. This is further analyzed and discussed in attachment "A."

The proposed study does little to advance the understanding of the role of pyrethroids in the Delta. The argument that the proposed study is a means to eliminate pyrethroids from consideration is incorrect. The limited geographic and temporal scope of the sampling involved will always leave the question of whether sampling was sufficient to accurately characterize pyrethroid effects. Conversely, finding toxicity in water discharged to the Delta does not provide any evidence that pyrethroids are causing the toxicity in Delta waters or effecting aquatic communities.

The SJC & DWQC would also like clarification of its responsibilities should monitoring performed on behalf of the Regional Board for this study find exceedances. Will management plans be required of the coalitions if exceedances are found in watersheds being monitored for this study by the Regional Board? Will coalitions be responsible for making contacts with growers based on the Regional Board's monitoring results for this study? These questions must be answered before the SJC & DWQC participates in any monitoring or other activities not under either their direct control or the current ILP program guidelines for the SJC & DWQC .

The SJC & DWQC realizes the need to study the Pelagic Organism Decline and whether inputs from Delta agriculture are having a detrimental effect. However, these issues must be addressed systematically and logically. based on peer reviewed scientific investigation.

Sincerely,

Mike Wackman
Special Consultant
San Joaquin County and Delta Water Quality Coalition

Attachment A

1) The proposal does not establish a formal hypothesis for evaluating whether pyrethroids are the cause of toxicity in discharge waters

Based on the design presented in the proposal, the null hypothesis for this study should be: There is no evidence of pyrethroid toxicity in water discharged to the Delta. The altemative hypothesis is that there is evidence of pyrethroid toxicity in water discharged to the Delta. To be testable, the null hypothesis must generate a testable prediction. To place the null hypothesis into a framework of testable predictions, the null hypothesis would be stated as: "If there is no evidence of pyrethroid toxicity in water discharged to the Delta, then toxicity tests performed on discharge water will not indicate significant mortality of *Hyalella* relative to the control." The "if' portion of the statement is the hypothesis and the "then" portion is the prediction. Additional predictions can follow the statement "If there is no evidence of pyrethroid toxicity in water discharged to the Delta..." such as: "...then toxicity tests performed on discharge water will not indicate significant mortality of ***Ceriodaphnia dubia*** (or any number of test species that one wishes to insert), or "then toxicity tests performed on discharge water from 30 locations will not indicate significant mortality of ***Hyalella*** relative to the control." As one builds the number of predictions by increasing the number and specificity of the "then..." statements, the robustness of the hypothesis increases. Unfortunately, in order to evaluate the null hypothesis in the proposed study, there needs to be greater specification of the prediction such as "If there is no evidence of pyrethroid toxicity in water discharged to the Delta, then every toxicity test will result in no toxicity" or "If there is no evidence of pyrethroid toxicity in water discharged to the Delta, then 95% of the tests will result in no toxicity" or some other standard. The standard would be based on one's willingness to commit a Type I error; is the willingness to reject the null hypothesis when in fact it is true.. A 5% standard seems reasonable and in keeping with current statistical evaluations of null hypotheses in the published literature. The design of this study does not address this issue and one can neither reject nor fail to reject the null hypothesis. Consequently, interpretation of the results will always be in question. For example, does a single sample with toxicity attributed to pyrethroids imply that discharge waters are toxic due to pyrethroids? And if one concludes that if there is toxicity attributed pyrethroid in one sample, can one then conclude that there is also a pyrethroid effect on aquatic communities in the Delta (but see below)? It is important to remember that the reason for rejecting or failing to reject the null hypothesis is so that the interpretation of results is not subjective and are therefore defensible. The lack of a specified prediction in the current study opens the results up to subjective interpretation. To put this in context, the study appears to propose conducting 106 toxicity tests and if the 5% standard is used, 6 significant toxicity tests would result in the rejection of the null hypothesis (no evidence of pyrethroid toxicity in discharge waters to the Delta). and therefore fewer than 6 significant toxicity tests would be expected simply by chance alone.

The question could be asked if the null hypothesis could be restated as the converse, i.e. "If there is pyrethroid toxicity in water discharged to the Delta, then toxicity tests performed on discharge water will indicate significant mortality of ***Hyalella*** relative to the control." The alternative hypothesis becomes there is no pyrethroid toxicity in water discharged to the Delta. By the same rationale used above, this conceptual hypothesis

and prediction would require further specification such as "If there is pyrethroid toxicity in water discharged to the Delta, then a single toxicity test performed on discharge water will indicate significant mortality of *Hyalella* relative to the control" or "If there is pyrethroid toxicity in water discharged to the Delta, then 95% of the toxicity tests performed on discharge water will indicate significant mortality of *Hyalella* relative to the control." The alternative hypothesis is that there is no toxicity. Once again, there needs to be a statement of the willingness to commit a Type I error in the evaluation of the "null" hypothesis. If a 5% standard is applied, of the 106 tests proposed. ***6*** would need to indicate no toxicity to reject the hypothesis. I.e. 6 tests should result in significant toxicity in order to fail to reject the null hypothesis and provide evidence for the conclusion that there is evidence of pyrethroid toxicity in discharge waters.

2) There is a confounding of conceptual and formal hypothesis testing and a misunderstanding of alternative hypotheses and their interpretation

Before examining how the current study results in a confounding of conceptual and formal hypothesis testing, it is important to understand the difference between the two and their roles in scientific research. The Popperian paradigm for how science is conducted states that when statistically evaluating a null hypothesis, there are two choices. One can reject the null hypothesis (H_0) or fail to reject the null hypothesis. The decisions can be represented as below:

Statistical Decision	True State of the Null Hypothesis	
	H_0 True	H_0 False
Reject H_0	Type I error	Correct
Do not Reject H_0	Correct	Type II error

The Type I error rate is the α value typically reported as the significance level in statistical analyses. The Type II error rate is not actually an error; it is the opportunity lost to make a correct decision; rejecting H_0. Neither of these concepts means that rejecting the null hypothesis is the same as accepting the alternative hypothesis.

A rejection of the null implies the statistical alternative; it does not necessarily imply the scientific or conceptual alternative. Statistical alternative hypotheses and conceptual alternative hypotheses are very different. This argument is outlined in an article by Denis (Inferring The Alternative Hypothesis: Risky Business, 2001, in Theory and Science, http://theoryandscience.icaap.org/content/vol002.001/03denis.html). A conceptual hypothesis is an explanation for a phenomenon. Reiection of a statistical null hypothesis allows an inference about the statistical alternative, but there could be numerous explanations, i.e. conceptual hypotheses, that are consistent with rejection of the null hypothesis. However, rejecting the statistical null hypothesis does not and should not directly imply an inference about any one conceptual alternative. Should the "truth" of both hypotheses be equated (i.e., that of the statistical and conceptual), one could easily infer conceptual alternatives that have no scientific meaning. As Denis points out, accepting a conceptual alternative is what led Ptolemy, based largely on measurements, to conclude that the sun orbited the earth. While the measurements supported the

rejection of the null hypothesis of no movement, they did not support acceptance of the alternative hypothesis that the sun moved about the earth, the alternative favored at the time by a segment of society.

Because the analytical tests in the proposed study are toxicity tests of water discharged to the Delta, the question becomes whether the predictions from the null hypotheses can be extended to effects in Delta waters. For example, can the conceptual null hypothesis and prediction be stated "If there is no evidence of pyrethroid toxicity in water discharged to the Delta, then there is no effect of pyrethroids on aquatic communities in the Delta" or conversely "If there is evidence of pyrethroid toxicity in water discharged to the Delta, then there is an effect of pyrethroids on aquatic communities in the Delta." To determine if it is reasonable to infer the alternative conceptual hypothesis as stated in the proposal based on the study design of the proposal, two questions must be addressed: a) is the alternative conceptual hypothesis logically consistent with current understanding of the evidence necessary to demonstrate an effect of a chemical in an aquatic system, and b) are there other alternative conceptual hypotheses that are consistent with evidence of altered aquatic communities?

a) To address the first question we must turn to the wording in the proposal:

The Surface Water Ambient Monitoring Program (SWAMP) has outlined a strategy for water quality monitoring of California's surface waters and identified indicators reflective of beneficial uses (SWAMP, 2005). The indicators used to assess pyrethroid pesticide effects on aquatic communities in the Sacramento San Joaquin River Delta will be:

1. Chemical analyses of whole, unfiltered water column samples.
2. Chemical analyses of the dissolved phase and the suspended sediment phase in water column samples.
3. Water column toxicity tests.
4. Water column toxicity identification evaluation procedures specific to pyrethroids.

These indicators will be used in an integrative manner to characterize the level of pyrethroid contamination, the potential for in-sheam biological effects and the specific links between contaminants and effects.

All indicators on the list are water column tests; however, water column samples for toxicity testing will be collected at only two locations at the entrance to the Delta. Additional water column samples are to be collected for the gradient analysis but subjected only to water chemistry. The overwhelming majority of the samples are of discharge water, not water column samples. The US EPA has provided sufficient documentation to link the results of standard toxicity tests to effects in ambient waters. The association was established primarily by assessing the aquatic communities themselves. But it is clear the appropriate link established by US EPA is between toxicity testing of ambient waters and the aquatic communities in those waters. Consequently, the conceptual alternative hypothesis that evidence of pyrethroid toxicity

in discharge waters infers adverse effects on aquatic communities in Delta waters should not be advanced.

b) There are clearly alternative conceptual hypotheses that provide mechanisms that result in adverse effects on aquatic communities in the Delta. Both the export of water from the Delta that result in changes in flows and water chemistry (e.g., salinity) and/or the actions of invasive species could be responsible for changes in aquatic communities in the Delta. Rejecting or failing to reject a null hypothesis regarding toxicity in water discharged (regardless of the cause of the toxicity) to the Delta does nothing to address the likelihood of the two other alternative conceptual hypotheses. Consequently, the causal link between pyrethroids and impacts on aquatic communities in the Delta can not be established by this study.